

1] Interpolation types :

- Linear interpolation
- Circular interpolation
- Parabolic interpolation

الماكينة تتحرك من X أو Y وتنتقل

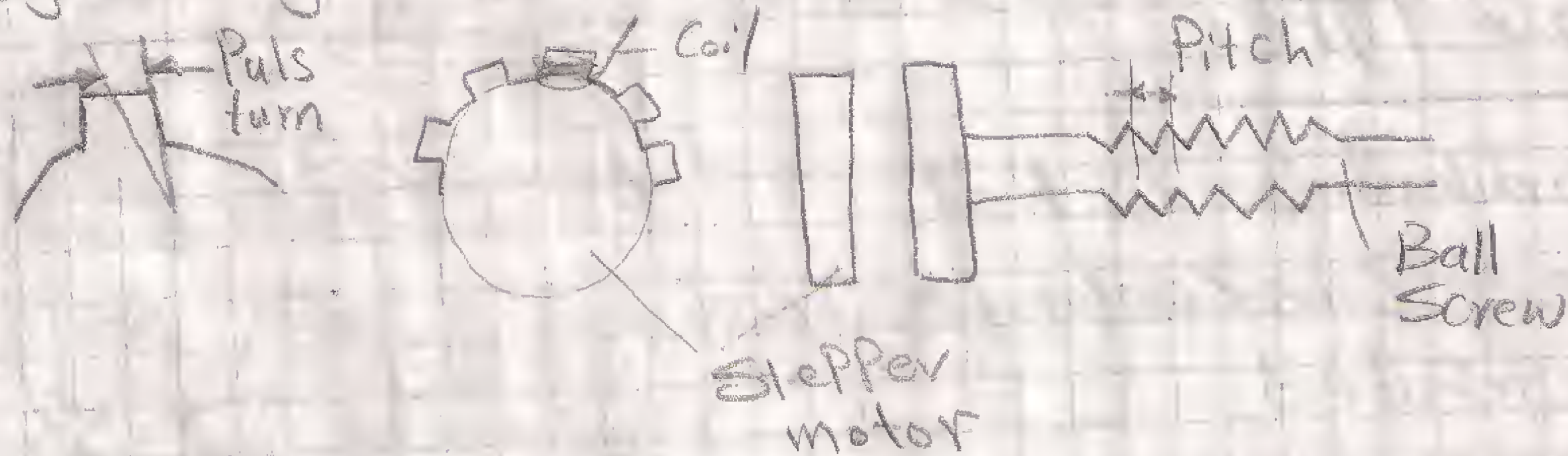
interpolation من نقطة إلى نقطة

2] Interpolation Can be performed by :

- Digital interpolation
- Analogue interpolation
- Soft interpolation

3] Digital interpolation :

By using D.D.A = digital differential analyzer



الحلقة يقوم بتوليد مجال مغناطيسي يدير على حركة العمود الزاوية

$$\text{Puls turns} = \frac{360}{\text{عدد الخطوات}} \quad \text{For Stepper motor in } \text{deg}$$

$$\text{Resolution} = \frac{\text{Pitch of ball screw}}{\text{Puls turn}} \quad \text{mm/Puls}$$

$$V_{\text{max}}^* = \text{max Puls rate P.P.S (Puls/sec)}$$

$V_{max} = \text{max. transverse speed mm/min}$

$$V_{max} = V_{max}^* \times \text{resolution} \times 60$$

$V_L = F = \text{required feed in part program, mm/min}$

or
$$V_L = \frac{F}{\frac{\text{rev}}{\text{min}}} \times S \text{ rpm}$$

$L_{max} = \text{maximum transverse distance}$

$$L_{max} = X_{max} = Y_{max} = R_{max}$$

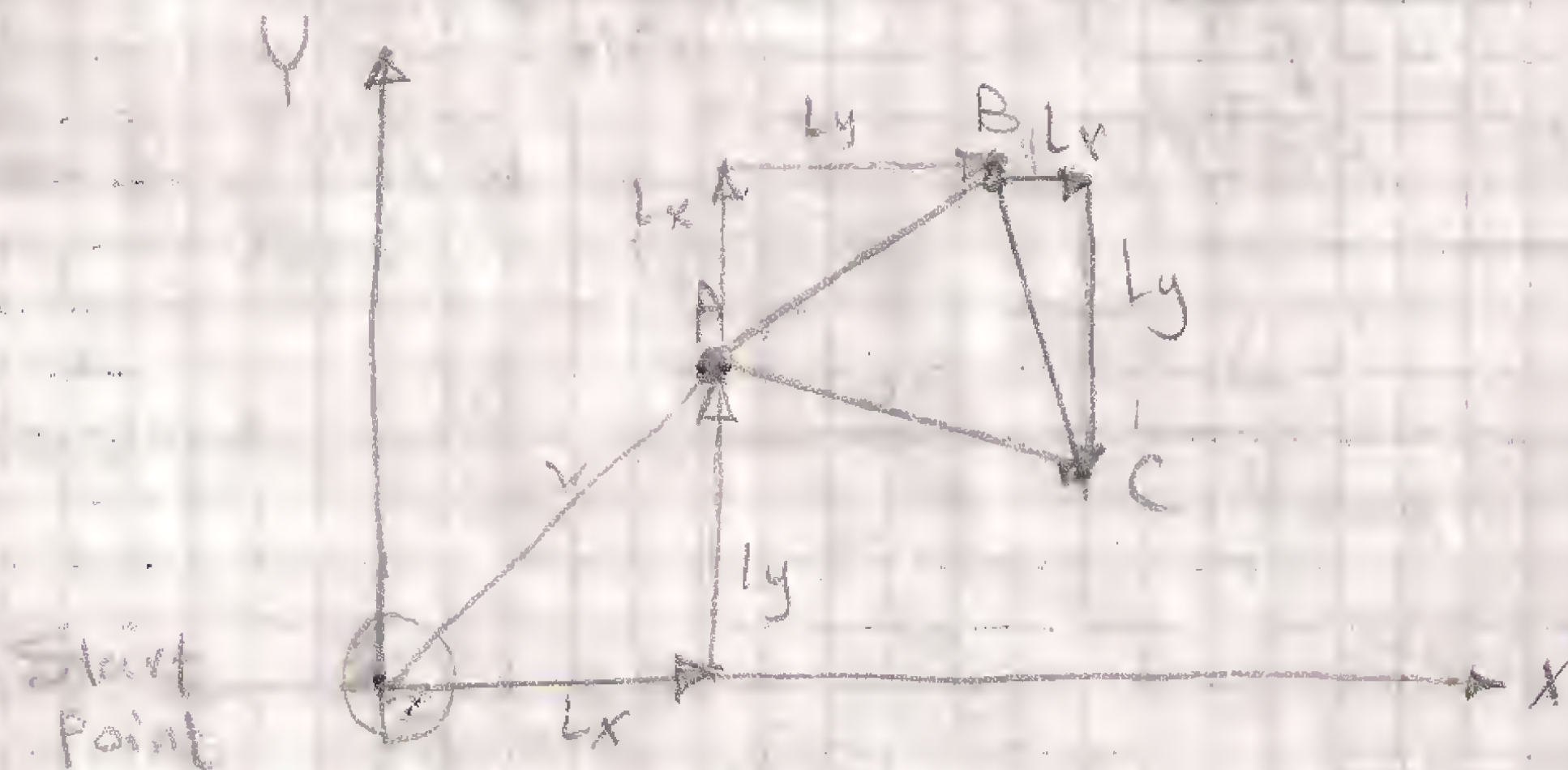
Case II Linear interpolation

Puls rate at any Point

$$V_x^* = V_{max}^* \times \frac{V_L}{V_{max}} \times \frac{L_{max}}{L} \times \frac{L_x}{X_{max}}$$

$$V_y^* = V_{max}^* \times \frac{V_L}{V_{max}} \times \frac{L_{max}}{L} \times \frac{L_y}{Y_{max}}$$

Example

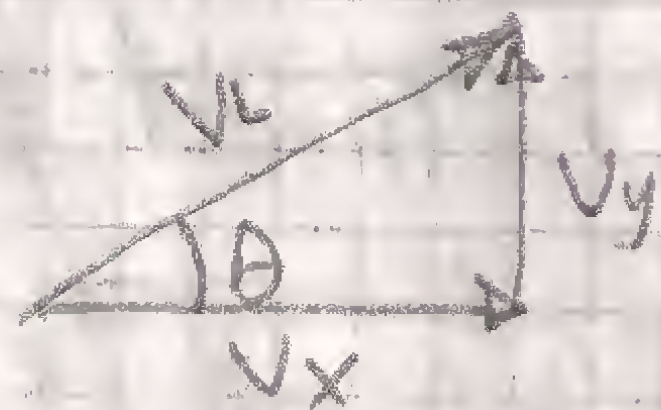
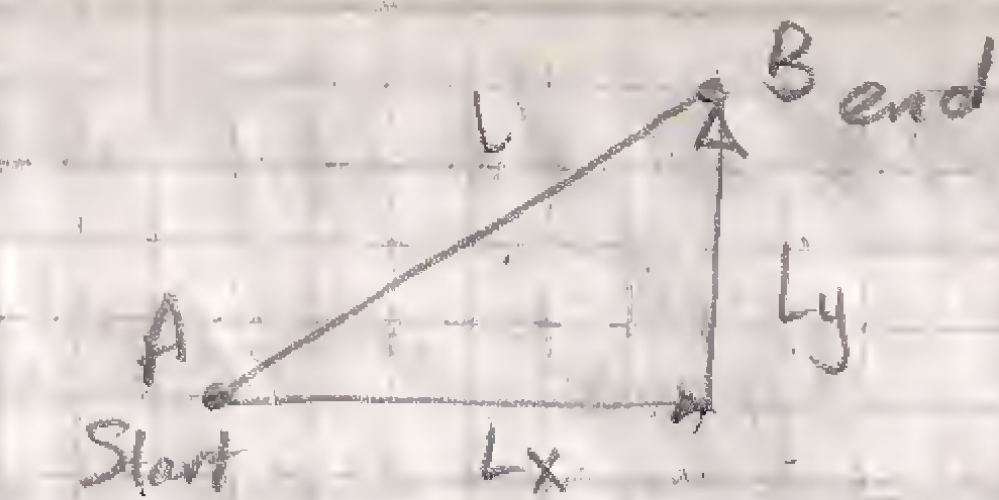


Start Point A, B, C are Puls rate

وثریم الی، و انی $\frac{L_x}{L_y}$ و L کی رے

for check results

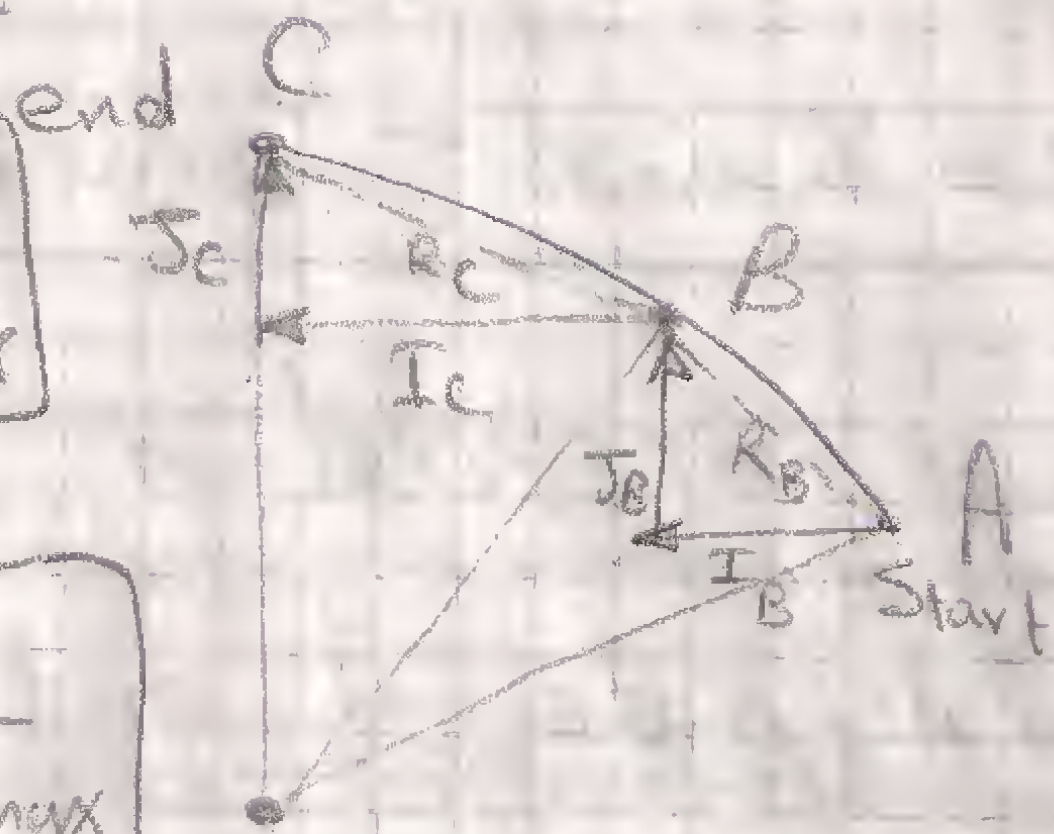
$$\begin{aligned} V_x &= V_x^* \times \text{resolution} \\ V_y &= V_y^* \times \text{resolution} \\ V_L &= \sqrt{V_x^2 + V_y^2} \end{aligned}$$



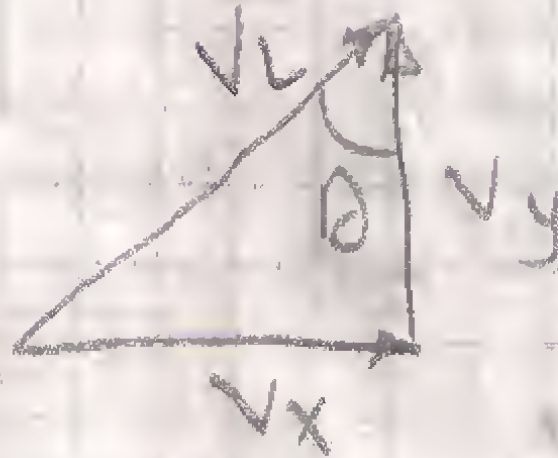
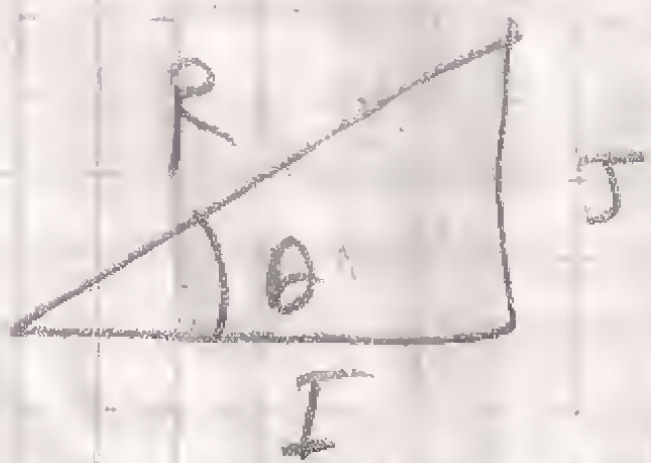
Cas 2 Circular interpolation :

$$V_x^* = V_{max}^* \times \frac{V_L}{V_{max}} \times \frac{R_{max}}{R} \times \frac{J}{J_{max}}$$

$$V_y^* = V_{max}^* \times \frac{V_L}{V_{max}} \times \frac{R_{max}}{R} \times \frac{I}{I_{max}}$$

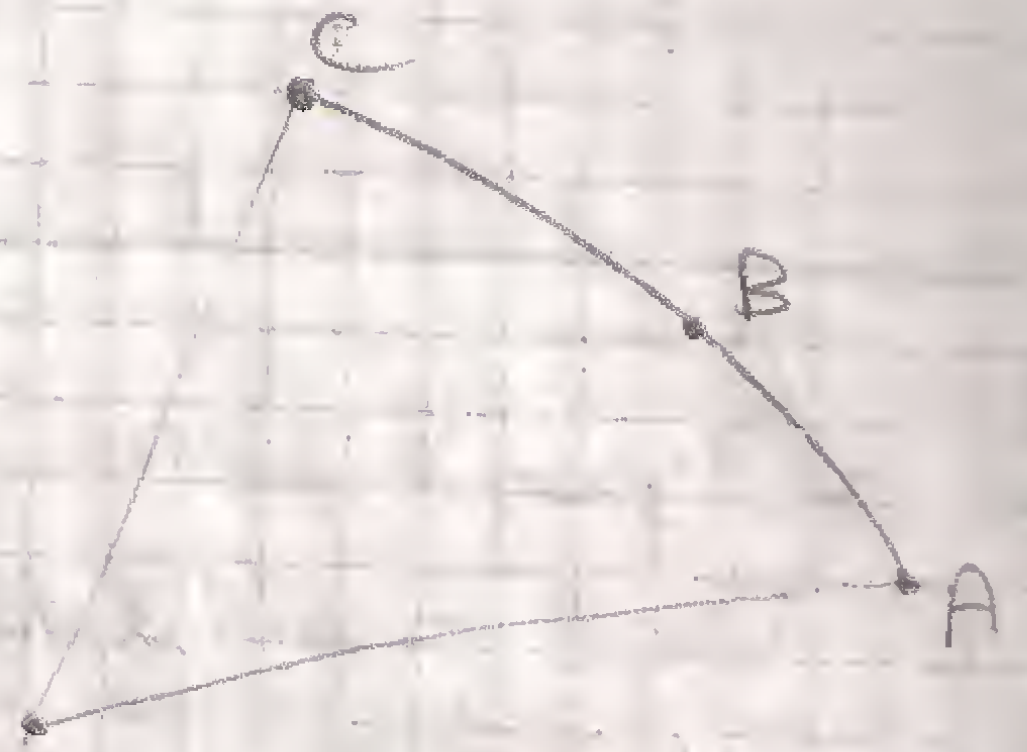


$$R_{max} = I_{max} = J_{max}$$



5] In a CNC M/C the maximum transverse speed
 20 m/min - the maximum pulse rate is 80000
 if required feed in the Part Program is 100
 while the machine is cutting the arc shown where
 Puls rate at the points A, B & C for each of
 two drives X & Y

Start from A



assume that

$$R_{max} = I_{max} = J_{max}$$

⇒ Pulse at Point (A) is equal zero

⇒ Pulse at Point (B) :

$$V_x^* = V_{max}^* \frac{V_L}{V_{max}} \times \frac{R_{max}}{R_B} \times \frac{J_B}{J_{Bmax}}$$

$$= 80000 \times \frac{100}{20000} \times \frac{J_B}{R_B}$$

$$V_x^* = 400 \frac{J_B}{R_B} \text{ Puls/sec}$$

$$V_y^* = V_{max}^* \times \frac{V_L}{V_{max}} \times \frac{R_{max}}{R_B} \times \frac{I_B}{I_{Bmax}}$$

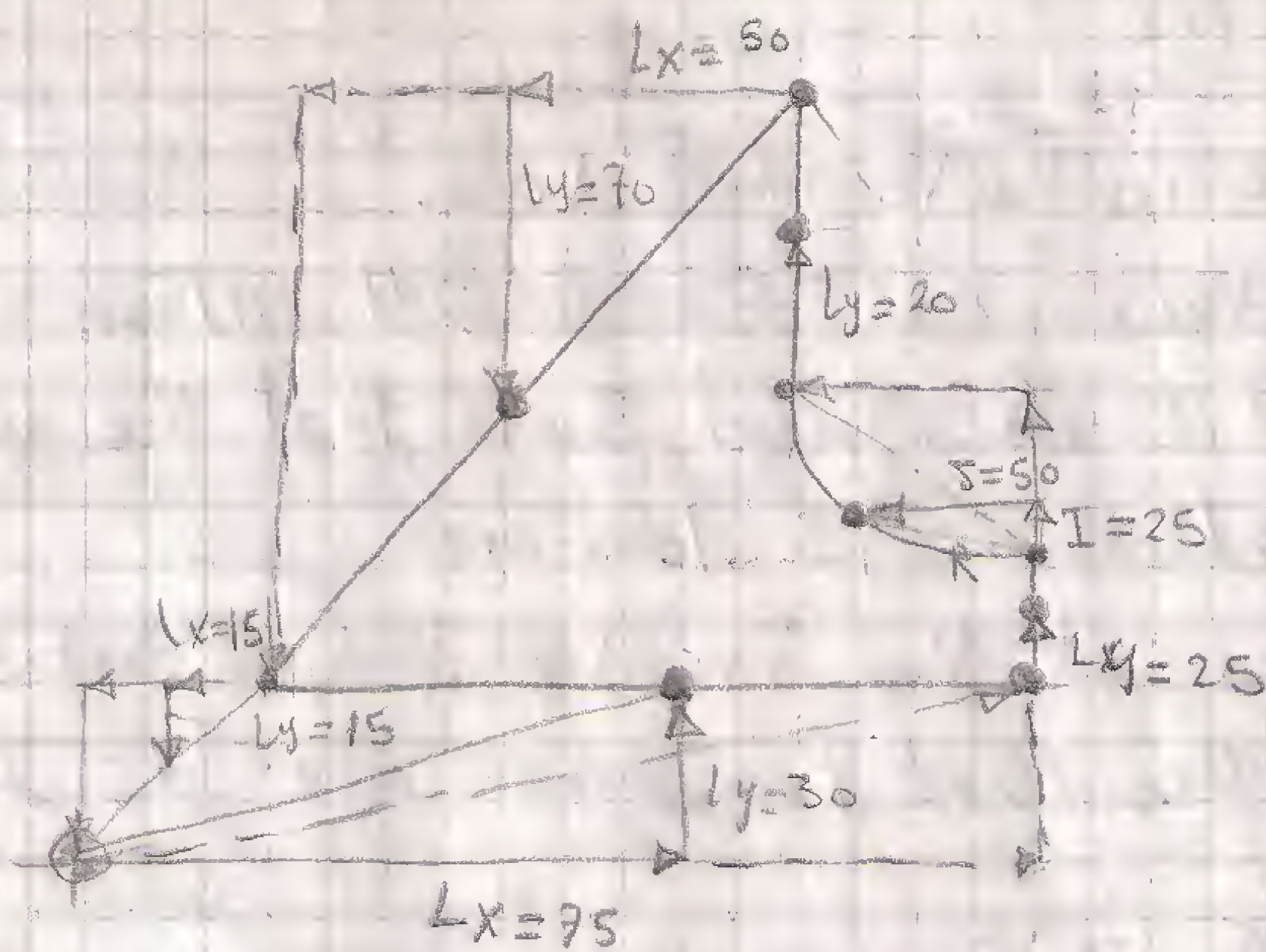
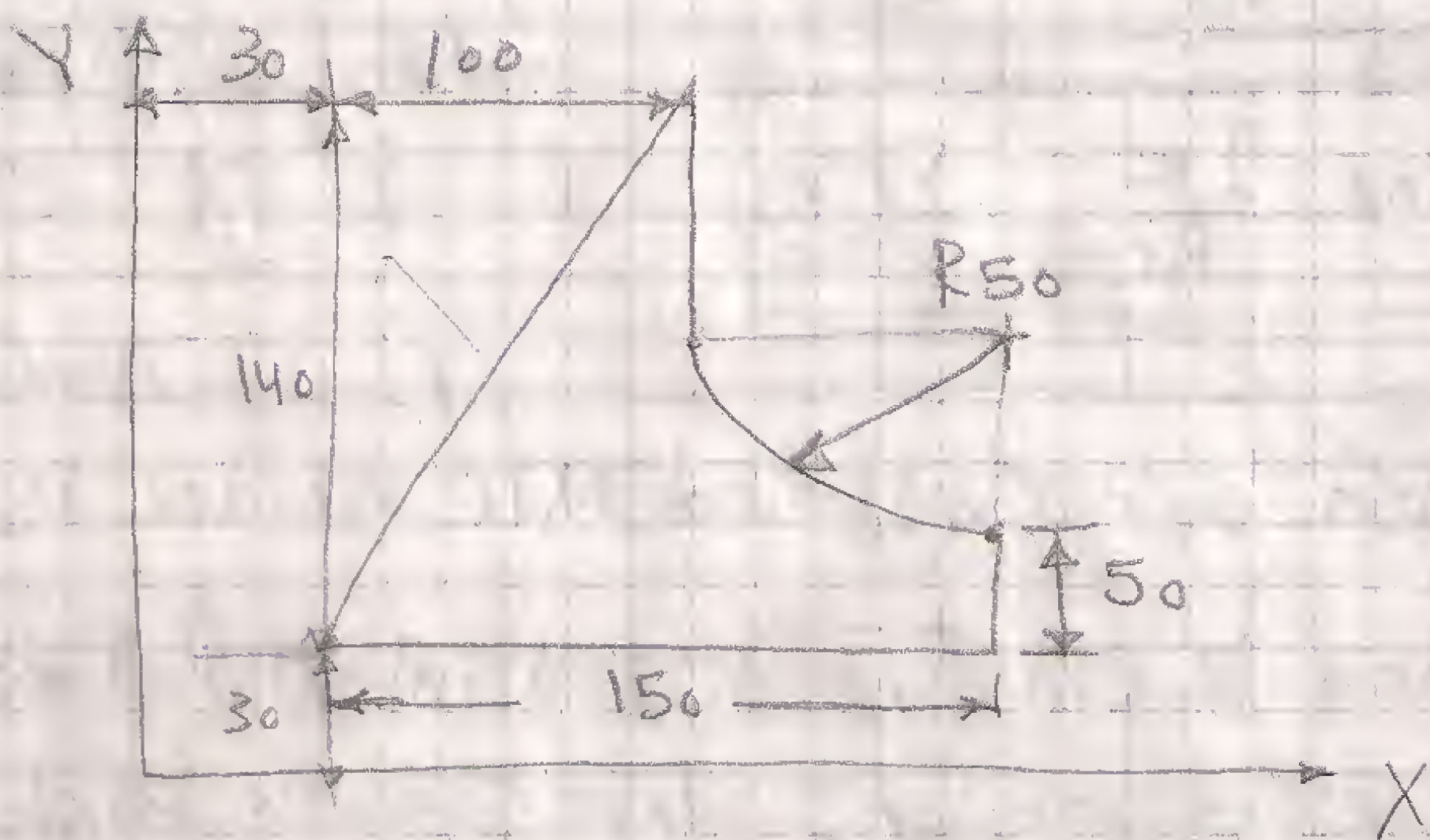
$$V_y^* = 400 \frac{I_B}{R_B} \text{ Puls/sec}$$

$$V_{max} = 20000$$

$$V_{max}^* = 80000$$

$$V_L = 100 \text{ mm}$$

Calculate the Pulses Generated by the Velocity Computer to each of the X & Y drivers at the Mid Points of each of the Passes created by block N/120, block N/130, block N/140, block N/150, block N/160 & block N/170.



Pathes through
mide Point of
each block

Pitch = 10mm
Pulsturn = 1.8
Vmax = 24000
Lmax = 1000 m

$$\text{Resolution} = \frac{\text{Pitch} \times \text{Pulsturn}}{360} = \frac{10 \times 1.8}{360} = 0.05 \text{ mm}$$

$$V_{\text{max}} = V_{\text{max}}^* \times \text{Resolution} \times 60$$

$$24000 = V_{\text{max}}^* \times 0.05 \times 60$$

$$\therefore V_{\text{max}}^* = 8000 \text{ Puls/sec}$$

for linear interpolation $V_L = F = 100 \text{ mm/min}$

for circular interpolation $V_L = F = 50 \text{ mm/min}$

Puls rate at Mid Point 8 For 8

Block N120

$$V_x^* = V_{\max}^* \times \frac{V_L}{V_{\max}} \times \frac{L_{\max}}{L} \times \frac{L_x}{X_{\max}}$$

assume $L_{\max} = X_{\max} = 1000 \text{ mm}$

$$V_y^* = V_{\max}^* \times \frac{V_L}{V_{\max}} \times \frac{L_{\max}}{L} \times \frac{L_y}{Y_{\max}}$$

where: $V_{\max}^* \times \frac{V_L}{V_{\max}} = \frac{100}{3} \text{ Puls/sec}$

$$V_x^* = \frac{100}{3} \times \frac{75}{\sqrt{(75)^2 + (30)^2}} \approx \boxed{31 \text{ Puls/sec}}$$

$$V_y^* = \frac{100}{3} \times \frac{30}{\sqrt{(75)^2 + (30)^2}} \approx \boxed{12.5 \text{ Puls/sec}}$$

Block N130

$$V_y^* = \frac{100}{3} \times \frac{25}{25} = \boxed{33.5 \text{ Puls/sec}}$$

$$V_x^* = \text{Zero}$$

Block N140

$$V_x^* = V_{\max}^* \times \frac{V_L}{V_{\max}} \times \frac{R_{\max}}{R} \times \frac{J}{J_{\max}}$$

$$V_y^* = V_{\max}^* \times \frac{V_L}{V_{\max}} \times \frac{R_{\max}}{R} \times \frac{I}{I_{\max}}$$

$$R_{\max} = I_{\max} = J_{\max}$$

$$V_x^* = \frac{50}{3} \times \frac{50}{\sqrt{(50)^2 + (25)^2}} = \boxed{15 \text{ Pulse/sec}}$$

$$V_y^* = \frac{50}{3} \times \frac{25}{\sqrt{(50)^2 + (25)^2}} = \boxed{7.5 \text{ Pulse/sec}}$$

Block N150

$$V_y^* = \frac{100}{3} * \frac{20}{20} = \boxed{33.3 \text{ Puls/sec}}$$

$$V_x^* = \text{zero}$$

Block 160

$$V_x^* = \frac{100}{3} * \frac{50}{\sqrt{(50)^2 + (70)^2}} = \boxed{19.5 \text{ Puls/sec}}$$

$$V_y^* = \frac{100}{3} * \frac{70}{86} = \boxed{27 \text{ Puls/sec}}$$

Block 170

$$V_x^* = \frac{100}{3} * \frac{15}{\sqrt{(15)^2 + (15)^2}} = \boxed{24 \text{ Puls/sec}}$$

$$V_x^* = V_y^* = \boxed{24 \text{ Puls/sec}}$$